WorldFish CENTER

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Aquaculture and markets: A research agenda

INTRODUCTION

The WorldFish Center is committed to meeting two key development challenges: (1) improving the livelihoods of those who are especially poor and vulnerable in places where fisheries and aquaculture can make a difference and (2) achieving large scale, environmentally sustainable increases in supply and access to fish at affordable prices for poor consumers in developing countries. This mandate demands a tight focus on issues that offer the greatest potential for poverty impact, conducted in a manner that fosters the translation of those research results into tangible benefits for the poor. Of necessity this involves choices, since there are never sufficient resources to pursue all avenues of development-worthy research - choices based on a critical assessment of potential poverty impacts as well as a keen understanding of where WorldFish Center's comparative advantage lies and how best to link it with the work of other key players.

WorldFish's aquaculture research focuses on production by small-holders and by small- and medium-scale enterprises (SMEs), and issues of access to input and output markets. It seeks to develop aquaculture technologies that do not compromise the supply of ecosystem services, such as water for irrigation and for household use, and that deliver pro-poor benefits through employment and access to affordable nutritious food. This agenda, which forms an integral part of the new CGIAR Research Programs[1], as set out in the CGIAR Strategy and Results Framework, is supported and complemented by related research on e.g., human nutrition and health, climate change and markets.

This issues brief proposes an agenda for markets and trade research that supports pro-poor development of aquaculture. It summarises key trends and issues relating to global aquaculture development and identifies critical markets and trade dimensions. Coinciding with renewed interest and change in global agricultural research, this brief is targeted to aquaculture development practitioners and researchers. It aims to provoke discussion on the key areas of markets-related analysis needed to ensure that aquaculture research delivers the strongest poverty reduction and food security outcomes. This focus means that the paper inevitably covers both markets and trade related research and identifies some critical gaps in the foundational poverty analysis.

The main aquaculture poverty impact pathways are then summarised along with an analysis of the ways in which work on markets and trade can support a pro-poor aquaculture research agenda. This is followed by a synopsis of the status of aquaculture globally, focusing particularly on the interface with the poor, whether as producers or consumers. A discussion then builds on that overview to identify research priorities tailored to specific country (group) scenarios.

The data presented are largely based on FAO[2] and country sources, whilst the discussion and analysis draw on the wider literature, including grey literature.

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[1] Details of the CGIAR SRF can be found at www.cgiarfund.org/cgiarfund/sites/cgiarfund.org/.../srf_feb20_2011.pdf ; most aquaculture research is framed within CGIAR Research Programs (CRPs) 1.3 and 3.7 (www.worldfishcenter/resource_centre/media/pdfs/CRP1.3_Final_4_March_2011.pdf and http://mahider.ilri.org/handle/10568/3248).

[2] Notably www.fao.org/docrep/013/i1820e/i1820e00.htm

POVERTY IMPACTS FROM AQUACULTURE DEVELOPMENT

Stevenson and Irz (2009) emphasise that the poor relate to aquaculture in a range of very different ways, so the scope for poverty reduction through aquaculture can be quite different in different settings, demanding (p. 298) "...an extensive assessment of its impacts [to] consider the multiple ways in which it can affect poverty."

Kassam (forthcoming) identifies different routes for potential poverty impacts from aquaculture development, e.g.:

- income effects (most often enhancing other sources of farm income);
- employment effects (potentially boosting demand for labour and driving up rural wages – though most studies show low use of wage labour in aquaculture[3]); employment effects may also stem from backward or forward linkages (i.e., increased employment in the value chain, in sub-sectors that support production or marketing of farmed fish);
- consumption effects, when the poor enjoy improved access to affordable fish; direct measurement of nutritional impacts is rare (ibid., citing Prein and Ahmed, 2000); analyses of price elasticities of demand tend to show elastic demand but such studies are limited, with quite mixed results;
- multiplier effects from forward and backward linkages (knock-on economic effects in the value chain) and (generally stronger) consumption linkages (i.e., through the expenditure patterns of those who benefit directly); although aquaculture multipliers have not been analysed, *agriculture* multipliers are a powerful source of rural pro-poor growth (responsible for an additional 30-50% of growth in other sectors (see Haggblade *et al*'s 2007 review));[4] and
- environmental effects, which can be positive or negative (e.g., nutrient-rich soil and water from ponds can be used in crop production, but harmful effluents may cause pollution and degrade common property resources).

Drawing on the ***agriculture*** literature, Kassam (forthcoming) stresses that:

> "...growth linkages are likely to be most beneficial for the poor when direct effects of increased production are equitably distributed as poor consumers tend to demand more local and labour-intensive goods than richer consumers. Growth linkages are also stronger when agricultural income is a high proportion of household income, initial asset distribution is relatively equitable, and economic capacity is underutilised (Hazell and Haggblade, 1993)."

- There may also be impacts on vulnerability to external forces such as market fluctuations or climate variability; the latter is well illustrated by Dey *et al.* (2007, 2010) from long term studies of smallholders in southern Malawi, which showed less impact of drought on incomes among those who had adopted aquaculture than those who had not.

Kawarazuka and Béné (2010) developed a framework to better understand the contribution of fisheries and aquaculture

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3 See Ahmed and Lorica, 2002 and Brummett, Lazard and Moehl, 2008.

4 Citing Hishamunda and Ridler (2006), Kassam (forthcoming) discusses a wide range of potential positive and negative "externalities", contrasting a virtuous "vent for surplus" scenario (seen e.g., in improved infrastructure and skills, or local re-investment of profits) with an "enclave" where there are few positive externalities (e.g., where there is imported labour, social disruption, low value added, etc.).

to the nutritional security of households with fish-based livelihoods: through fish consumption by producing households, via income effects enabling households to improve their overall dietary intake, and by focusing particularly on women as producers who are more likely to use enhanced income status to improve household food security. They find gaps in the literature on all three routes concluding that in general there is insufficient evidence to show nutritional impacts on households involved in fish-based activity[5]. Nutritional impacts on the wider population from enhanced fish supply were not explored.

MARKETS AND TRADE RESEARCH IN SUPPORT OF PRO-POOR AQUACULTURE DEVELOPMENT

Markets are an inherent part of the context within which economic activity takes place. They influence, and are influenced by, the behaviour of producers and consumers. When they function well (providing the goods and services people want at reasonable cost), they generate incomes and foster wider economic growth opportunities. When they function poorly (when the desired goods and services are not readily available at reasonable cost), they act as a brake on economic activity. Of course, there is important and considerably more nuanced detail behind such generalisations. Markets may work well for certain population groups – securing incomes and consumption for higher income groups –while failing to provide the goods and services needed by the poor. As will be seen below, the pervasiveness of markets means that there is a potential markets dimension to most areas of research; markets are a critical part of the context that determines whether and how poor people realise gains in nutrition or incomes. In many parts of the world,

women play an active (sometimes dominant) role in fish processing and marketing – so value chain assessment and interventions can have important implications for women's incomes.

The ways in which research on markets can inform and strengthen pro-poor aquaculture research can be categorised as follows:

- through critically important analysis of fish market trends, providing context on overall shifts in supply and demand, hence pointing up areas of growth or decline (with relevance and potential application at different scales, ranging from global trends to the specifics of local markets); moreover, where such studies focus on the products produced or consumed by poor people, this provides important information on the poverty impacts of different trends and scenarios[6];
- through analysis of *how* the poor are impacted by aquaculture; do poverty impacts occur through consumption or through livelihoods? And if the latter,

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5 There is some evidence, however; see Islam *et al.* 2008.

6 Where such analysis underscores exacting market requirements, it suggests that the poor will face higher barriers to entry than those with a stronger asset base (e.g., skills, business networks, financial capital, access to appropriate infrastructure etc.). Analysis of market trends may also highlight important developments relating to low-value food fish, which could inform further work on the poverty impacts relating to consumption.

are those livelihoods in production itself, or in the supply of related goods and services, or via the expenditure patterns of those whose incomes increase through aquaculture? Or poverty impacts could be more specific – where aquaculture may offer an entry point for work on other issues with particularly vulnerable groups, or create synergies with other livelihood activities. Answers to these questions, many of which have market dimensions, can inform the *focus* of aquaculture research;

- through targeted research to complement and fine-tune specific research projects; so, e.g., where the poor benefit directly as producers, by analysing the market access constraints they face and piloting pro-poor market access solutions; or where they benefit as consumers, by conducting market research to understand poor people's preferences (price, product, place etc.) and using that information to guide the development of interventions that improve poor people's access to food fish or to help target supply-side research and policy.

In practice, much research tends to focus on (a) understanding markets and (b) promoting the participation of the poor as producers, with much less work on understanding ***how*** the poor benefit from aquaculture development, and particularly on understanding (often assumed) consumption and nutrition impacts. In situations where aquaculture does deliver increased supply and lower prices, those market effects may adversely affect other vulnerable groups, notably fishermen. Stevenson and Irz (2009) also emphasise the need for a better understanding of how the poor benefit as paid labourers, since in Asia this is an increasing trend.

Within WorldFish, aquaculture research is focused on increasing supply for increased consumption by the poor (linking to CRP 3.7) and on the potential of aquaculture as a livelihood for vulnerable populations (linking to CRP 1.3). Both cases incorporate a value chain approach. Complementary work on the important role of fish in human nutrition and health will take place through CRP 4.

GLOBAL TRENDS IN AQUACULTURE

Globally, fish production (from capture fisheries and aquaculture) is steadily increasing, with aquaculture becoming more important as capture fisheries stagnate or decline. Thus, in 2008, total world food fish output was 115 million tonnes (representing annual average growth of 2.5% over the previous 4 years). The share of aquaculture in total food fish supply was 46% in 2008 with production of 52.5 million tonnes and annual average growth of 7.8% over the previous four years. Thus it is clear that aquaculture is an important and growing source of food fish production.

In 2008, Asia accounted for 89% of world aquaculture production by quantity and 79% by value. China alone accounted for 62% of production by quantity. Six Asian countries, all producing in excess of 1 million tonnes of aquaculture products, together account for 81% of global aquaculture production: China, India, Vietnam, Thailand, Indonesia and Bangladesh. Although annual growth rates are more rapid in other parts of the world, including some African nations (Africa includes 5 of the top 10 fastest growing aquaculture sectors), overall production levels remain relatively low. Egypt is an important producer (almost 700,000 tonnes in 2008) but sub-Saharan Africa accounts for only 0.5% of global aquaculture output.

FAO reports that freshwater aquaculture accounts for 60% of production, whilst marine and brackish environments account for 32% and 8% respectively. Although freshwater finfish are the most important group by volume and value, brackish water aquaculture (which includes high value finfish and crustaceans) accounts for 13.3% of sector value (almost double its share of production volume).

Fish and fishery products are highly traded: in 2008, 39% of production was traded internationally as food and feed products. Although international trade is largely focused on high value species, there is an important and growing trade in low value species such as *Pangasius* (within countries or producing

regions and more widely). Many of these species are farmed and many areas of high growth in aquaculture production are also witnessing rapid growth in exports. Export growth rates for important farmed fish such as tilapia and catfish currently exceed 50% per annum (FAO, 2009). Farmed shrimp are more important than wild production in global trade, and molluscs, an important and growing aquaculture sub-sector, are also important in global trade in aquatic products.

The top ten exporters of fish and fishery products include three Asian nations, accounting for 21% of global export value (China, Thailand and Vietnam). The other top exporters are the USA, Canada, Chile and four European nations. The top ten importers are Japan, USA, six European nations, China and the Republic of Korea. The dominant trend is that developing countries export (>50% of global export volume) to developed countries (>80% of global import volume) (Kelling, 2011).

Consideration of patterns in fish consumption reveals large variations in food fish availability and trends. Globally, per capita food fish supply in 2008 was estimated as 17.1 kg. Consumption has been increasing as a consequence of increasing urbanisation (which tends to be associated with higher consumption of animal protein) and income growth. Irrespective of the accuracy of these global averages, analysis of the trends in regions or countries is more informative. Broadly speaking, three groups can be distinguished:

Europe, Australia and North America:
>20 kg/ capita/ annum

Asia (excluding China[7]):
c.14 kg / capita / annum

Central America, South America and Africa: < 10 kg/capita / annum

Within these broad groups, there are large differences between and within countries. Of particular note is that average apparent per capita food fish supply in low income food deficit countries (LIFDCs[8]) (excluding China) was only 9 kg in 2007. Despite low absolute levels of fish consumption in the LIFDCs, on average fish nonetheless accounted for 20% of animal protein supply (and much more in some countries[9]). Its dietary role in providing key micro-nutrients (vitamins, minerals) - the small whole fish often consumed by low-income groups are a particularly rich source of such nutrients (WorldFish, 2011) - and in the provision of essential fatty acids, especially to lactating mothers, is also important.

Farmed fish is an increasingly important source of food fish supply – not just for export but for domestic markets too. Much of the increase in the production of low-value freshwater species is destined for domestic markets, particularly in Asia, where relatively easy market access contrasts sharply with the more sophisticated demands in higher-income countries. Premium-quality outlets are increasingly demanding not just food safety, freshness, diversity and convenience but also assurances about health giving qualities as well as environmental, social and ethical credentials.

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7 Apparent per capita consumption per annum in China is 26 kg.

8 The 2008 list of LIFDCs contains 77 countries, 68 of which are in Asia or Africa. This includes most of the countries in which WorldFish has a significant presence (Ghana, Malawi, Egypt, Zambia, Bangladesh, Cambodia, Indonesia, Philippines, the Solomon Islands, Uganda (from 2011) and Mali (proposed)).

9 e.g., at least 50% of total animal protein intake in some small island developing states, as well as in Bangladesh, Cambodia, Equatorial Guinea, French Guiana, The Gambia, Indonesia and Sierra Leone.

With aquaculture relatively undeveloped in Africa (except Egypt), the provision of support services is still patchy. In those African countries where there are signs of "take-off" (e.g., Nigeria and Uganda), commercial provision of seed and feed is improving, enabling SMEs and large-scale operations to emerge whilst many small producers, although demonstrating interest through investment in pond and cage culture, are still struggling to assure adequate access to input and output markets. Within that general picture of weak uptake in Africa to date, much small-scale production is characterised by low fish yields, integration with agricultural operations (sometimes with striking benefits to the farming system; see Dey ***et al***. 2007, 2010) and weak market orientation.

By contrast, in many Asian countries, the aquaculture sector is much more developed and its structure reflects a diversity of production types. Whilst larger farms deploy intensive systems and wage labour, there are also an estimated 16-17 million small-scale farmers. Both groups produce for export markets and growing domestic markets too. Whilst in general, in those countries with well-developed aquaculture sectors, access to inputs and output markets is much less constrained than in Africa, many small-scale producers nonetheless face problems with market access and sourcing quality seed, affordable feed and finance (Ahmed, 2010).

Identification of key issues for reducing poverty and hunger: implications for research

Key findings that emerge from this overview include:

- aquaculture's important and growing role in global fish supply, trade and diets
- Asia is the dominant producer – supplying both domestic and export markets
- fish consumption in low-income food deficit countries is, on average, markedly lower than global or comparable regional averages, and
- Africa has very low aquaculture production, despite stagnating or declining capture fisheries production and the important dietary role of fish in many African countries.

These findings suggest some key priorities for developing countries, including:

- assuring that the growth in aquaculture in Asia generates livelihoods for the poor
- assuring higher rates of fish consumption in LIFDCs, and
- increasing fish supply and livelihoods from aquaculture in Africa.

Each of these broad priorities is explored below, to identify the areas of greatest need and best prospects for pro-poor outcomes from research on aquaculture and markets.

In addition, contextual research on global fish product markets remains important. Regularly updated analysis of the overall status of and trends in global fish markets provides an important frame of reference in which aquaculture development needs to be framed. However, more specific research on e.g., trends in particular countries or the requirements of particular value chains fits more naturally within some of the research areas discussed below.

Assuring that the growth in aquaculture in Asia generates livelihoods for the poor

The scale and nature of aquaculture development in Asia permits the participation of the poor in numerous ways:

- through employment or labouring on large-scale commercial fish farms
- through own enterprise, with 17 million small-scale aquaculture farmers
- through employment or enterprise in the value chains, noting particularly that both export and domestic markets are important in Asia, with differing characteristics supporting different types of service industries.

Key research topics include:

1. estimating the potential livelihood benefits through engagement by the poor in each of the different aquaculture sub-sectors outlined above, including an assessment of the relative benefits from engaging

through employment or labouring versus own enterprise; such research results have strong implications for policy orientation and the focus of research and development investments;

2. analysing different types of value chains and their pro-poor livelihood potential (again, including consideration of own enterprise versus employment or labouring involvement) – once again, with strong implications for the focus of research and development investments;

3. for products with livelihood potential, exploring the market-related constraints to stronger pro-poor outcomes – to inform research on technology and institutional development; (e.g., small-scale producers often face difficulties in accessing input and output markets[10]; experience in other sectors points to potential solutions through collective action and public-private-partnership); and

4. policy analysis with a particular focus on the identification (and scope for removal) of market distortions that penalise small-scale operators or otherwise inhibit the generation of livelihood opportunities for the poor (see Beveridge *et al.* 2010); Allison (2011) discusses the elements of a pro-poor fisheries and aquaculture policy underlining the need for policy coherence and a stronger policy research base.

There is growing interest and research on topic (3) above (and particularly on institutional development[11]), including WorldFish research in the Ganges and Mekong basins and in the Solomon Islands but, it seems, relatively little work on the other topics. In the absence of that foundational work, particularly on topics (1) and (2), whilst work on (3) is still worthwhile, it is not clear that it is the best bet for delivering the strongest impacts on poverty reduction. Policy (4) also remains an important and under-researched area.

Assuring higher rates of fish consumption by the poor in LIFDCs

This is an area where very little is known. Whilst fish consumption can be and often is very important in the diets of the poor[12], very little is known about the circumstances in which it does actually deliver benefits in terms of nutrition and health (and particularly critical issues relating to affordable processed fish, often smoked or dried, so common in the diets of the poor and the different nutritional benefits of different species). A much better understanding is needed of the circumstances under which poor and vulnerable consumers benefit – and hence the implications for development investments.

This gives rise to a set of research questions relating to markets, the nutritional role of fish and target groups, including:

- understanding fish markets in target countries (especially in countries with high rates of malnutrition) – probing particularly market size and trends, segmentation (product, place, price, consumer group), purchasing behaviour and per capita purchases by different consumer groups, income and price/cross-price elasticities of demand for fish[13];
- understanding fish consumption and nutrition (how food is prepared and shared in the home or outside) and the nutritional benefits (or risks) of eating fish (main species) and different parts of fish (e.g., small fish consumed whole are particularly rich in micro-nutrients), in different forms (fresh, dried etc.); linking this understanding to information about the costs and feasibility of realising

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10 Note that the important area of linked research on water resources governance, where the market is more often "implicit" but the manner of its functioning is a critical determinant of aquaculture and poverty outcomes.

11 including considerable focus on access to high-value (often export) markets

12 Fish is a potentially important source of protein, essential fatty acids and micro-nutrients including Vitamin A, iron, calcium, zinc and iodine (WorldFish 2011). Vitamin A, iron and iodine are perhaps the most important micronutrients in terms of health consequences for poor people (www.worldhunger.org).

13 i.e., the extent to which the volume of fish purchased changes with respect to changes in income, fish prices or the prices of other foods (notably substitutes or complements).

comparable nutritional benefits by other means – and hence highlighting where the focus on fish consumption is most (or less) critical[14];
- where such analysis gives rise to very clear target groups, developing a detailed understanding of influences on fish purchase and consumption behaviour to inform work on increasing consumption by target groups and research on supply-side constraints;
- the analysis of policies and policy interventions that relate to markets, e.g., subsidies, minimum or maximum prices, tax/export discounts and quotas; and
- using the improved understanding of markets and consumer behaviour to estimate the nature and volume of fish supply needed to make a difference and exploring whether that is best pursued via fishing, fish farming or trade.

Assuring higher rates of fish consumption by the poor is a particular focus for WorldFish in its aquaculture research in Uganda, Zambia and Egypt. In Zambia, annual per capita fish consumption is estimated to have fallen from 17 kg in 1974 to just over 6 kg in 2010 (Runnebaum et al., 2011), whilst Uganda falls in the mid-range (15-18 kg). However, simple averages conceal much lower consumption rates by some groups. In these countries and in other LIFDCs in Asia and in Africa, linked research on fish markets, consumption and nutrition can address important gaps in understanding and improving poor people's access to critically important micro-nutrients, lipids and animal protein. This is a critical complement to research on aquaculture production systems, aiming to increase the supply of farmed fish.

Increasing fish supply from aquaculture in Africa

Fish remains an important source of animal protein in many African countries (Allison et al. 2009), with strong anecdotal evidence to suggest that dried and smoked fish are widely consumed by poor people (WorldFish, 2011). However, population increase, flat or declining capture fisheries landings and generally low levels of aquaculture development, mean that per capita consumption is declining. Further development of aquaculture potentially offers both livelihoods and nutritional benefits for the poor. WorldFish has identified Uganda and Zambia as a particular focus for its work on this topic.

The demands of this still new sector in Africa suggest three broad areas of market-related research:

1. developing an improved understanding of where the strongest potential for poverty impacts lies (via livelihood or consumption impacts); this requires an analysis of fish markets and consumption by different groups to indicate the nature and scale of the changes required "to make a difference" to the nutrition of target groups (the poor, women and children), coupled with a (most probably qualitative and peer-reviewed) assessment of the status of, potential for and likely impacts of aquaculture growth based on alternative realistic development strategies (e.g., large or small-scale market-oriented aquaculture, subsistence-oriented farms etc.); a welfare economics approach can help here but an assessment of nutritional benefits is also important (because these will not be adequately captured by analysis of producer and consumer surplus);

[14] A related area of nutrition research would examine the effect of fish consumption on the disability-adjusted life year (DALY). The DALY is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

2. where the strongest poverty impacts relate to nutritional benefits of increased consumption, exploring the issues outlined above for consumption in LIFDCs, thus

    - understanding fish markets
    - understanding fish consumption and nutrition
    - understanding the purchasing / consumption behaviour of target groups
    - assessing the volume and nature of the increase in fish supply needed and whether that is best pursued via fishing, fish farming or trade;

3. where strong livelihood impacts are possible, this gives rise to questions similar to those discussed above for Asia, thus

    - assessing where there is the greatest potential for livelihood gains (through own enterprise, labouring or in the value chain)
    - analysing the pro-poor potential of different types of value chain
    - addressing value chain constraints to stronger pro-poor outcomes, and
    - policy analysis to identify distortions that penalise the poor;

    In Africa, where the development of rural market systems lags that seen in Asia, this is likely to lead to the development of a different research agenda (e.g., with more work on integrated-aquaculture-agriculture and more accessible local markets).

Emerging priorities for research on markets and trade

This review points to a broad agenda of market-related research, which both confirms the importance of certain existing emphases and points up some significant gaps.

The overall contextual work on global trends is largely available from sources such as FAO and IFPRI, though there is a need for carefully targeted collaborative work where more detail is needed on particular regions or topics (e.g., under-recorded intra-regional trade in sub-Saharan Africa) [15].

Within Asia, there has been a focus on assuring greater participation of the poor in aquaculture production and value chains through institutional development. This focus seems to be based on an *assumption* that this is the way in which research can most effectively deliver pro-poor benefits. It seems, particularly, that there has been relatively little comparative analysis of how the poor benefit most (as labourers or employees, through their own businesses or as consumers) nor of the pro-poor potential of different value chains. Addressing some of these gaps would provide a stronger rationale for the existing focus or new research.

Research that links analysis of aquaculture markets, consumption and human nutrition is a relatively new focus for WorldFish – echoed in current work in sub-Saharan Africa being pursued under CRP 1.3 and CRP 3.7 and in CRP 4 (nutrition). This brief highlights an urgent need for more work on this important topic – work that should inform further research and could lead to new areas of research (e.g., on influencing consumer behaviour).

Africa, with its slowly emergent, patchy aquaculture sector, is the area where there has been the least empirical work on aquaculture and where there remains the poorest understanding of how the sector can deliver poverty impacts. Yet aquaculture holds considerable promise, seen in both private and public interest, as well as in robust and growing domestic markets, linked to the apparently important dietary role of fish to many African populations. But there has been almost no work on consumption patterns and how fish products deliver nutritional benefits and for whom. Moreover,

[15] One such example is the recent "Fish to 2030" work, which uses modeling and other analysis to explore the poverty impacts of likely future market scenarios (e.g., increased trade, growing urban demand, declining capture fisheries, etc).

although there is widespread interest in an SME model for aquaculture development in Africa (and a related emphasis on access to inputs and the co-ordination of output marketing), there are still many apparently marginal small-scale producers with weak market linkages whose production is often over-looked in official data and by policy-makers. There has been almost no analysis of these alternative development paths and the relative benefits of each. Within Africa, there is a pressing need for more "foundational" analysis to help focus aquaculture development efforts on those avenues that hold the greatest promise for pro-poor outcomes.

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